

Chapter IX

MAINTENANCE

There has been a long history of struggle against malaria since the beginning of this century. A large-scale chemotherapy program undertaken by the Japanese government during the period 1910-1944 achieved good malaria control, but malaria transmission was not interrupted. A six-year malaria eradication program using DDT residual house spraying was launched in 1952, followed by vigorous malaria surveillance activities which finally eliminated all the remaining transmission foci. The number of malaria cases, conservatively estimated in 1952 as 1.2 million, was down to zero in indigenous transmission by early 1960s. The malaria cases registered since 1974 have all been imported cases (Fig. 74).

In January 1965 the malaria eradication program in Taiwan made a significant and challenging step forward into the maintenance phase, a phase of uncertain duration until the day when the whole world is rid of malaria. Starting from the beginning of that phase, the official responsibility for malaria vigilance has been completely turned over to the general health services. TAMRI, which played an essential role during the attack and consolidation phases, was to remain as a nuclear technical unit at the provincial level to provide technical supervision and coordination of malaria work for the 23 county health centers and 383 township health stations. On the other hand, TAMRI was expected to gradually broaden its scope of activities into the fields of parasitology and medical entomology. The idea of converting TAMRI into a provincial institute of tropical medicine originated in 1961, and possible financial assistance from ICA/CUSA was negotiated. In the same year, a committee of 14 men, including health specialists and representatives of PHA, ICA/CUSA and TAMRI, was organized to plan the future programs and the construction of a new building for the institute. Originally, the new institute of tropical medicine was planned to have its own building, in either Kaohsiung or in Changhua, but it was finally decided by PHA to share the costs of a larger five-story building with the Institute of Environmental Sanitation and the Serum and Vaccine Laboratory. The new building was completed in 1969 in Nankang, Taipei city, with funds provided by PHA and ICA/CUSA. TAMRI moved from Chaochou, southern Taiwan, to this new building at the end of March 1969 and began functioning from April 1, 1969. Inasmuch as TAMRI had already broadened its activities in collaborating with the general health services in the control of filariasis since 1958, it

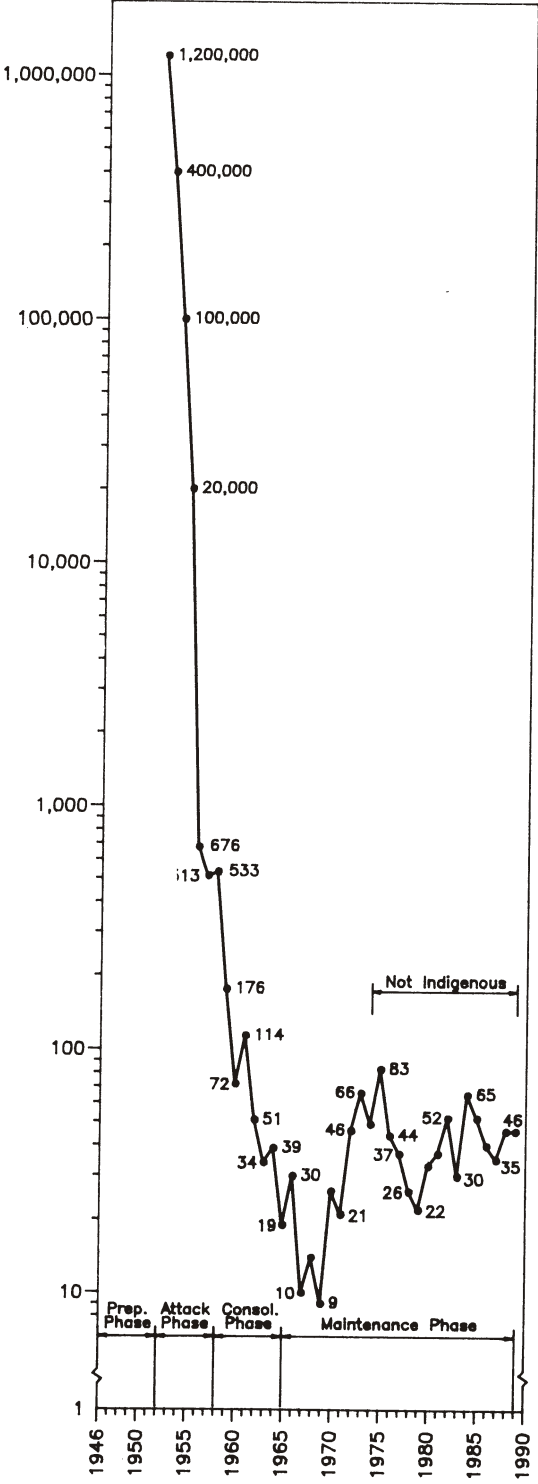


Fig. 74:

Decline and fall of malaria in Taiwan

Number of malaria cases between 1952 - 1989 (presented in semi-logarithmic scale)

was officially renamed "The Provincial Institute of Infectious Diseases (TIID)," effective December 16, 1974. The activities of TIID included malaria vigilance (priority program), filariasis control, studies of Japanese encephalitis vectors, and epidemiological investigation of intestinal parasites. As the priority program, malaria vigilance still counted on 20-25 technical staff members working full time on activities emphasizing international travelers' control, epidemiological investigation, entomological monitoring of *An. minimus*, supervision and guidance for adequate case detection programs, and elimination of transmission foci, should such needs arise.

On September 30, 1988 TIID was incorporated into the "National Institute of Preventive Medicine (NIPM)," Executive Yuan. TIID was dismantled and its staff members separated into four groups - namely medical entomology, epidemiology, malaria and parasite diseases, and administration. The medical entomology group became a new independent section, while epidemiology and administration personnel were absorbed by the respective existing sections of NIPM. The original TIID is now merely an NIPM section of "Malaria and Parasitic Diseases." As far as malaria is concerned, there are 15 staff members (nine permanent and six temporary), of whom seven are microscopists for rechecking blood smears sent by county laboratories, two are office caretakers, two are office clerks, and four are technical staff for coordinating, supervising and guiding malaria vigilance activities of the general health services. The major activities since the initiation of the maintenance phase of the malaria program (January 1965) are summarized in the paragraphs which follow.

SCREENING OF ARRIVING TRAVELERS AS POTENTIAL PARASITE CARRIERS

Travelers arriving or returning from malarious countries were requested to fill out a simple questionnaire as to where they had stayed within the previous two weeks and where they could be contacted in Taiwan (address of residence or name of hotel). The forms were collected by the quarantine officers at ports of entry and were forwarded to TAMRI every day. They were reviewed, sorted and forwarded to the appropriate health stations through county health centers. The time lapse between arrival of the travelers and delivery of the forms at health stations averaged one week. This system worked rather well in the initial stage, but gradually showed signs of relaxation or deterioration among the collaborating health agencies as the number of travelers from malarious countries steadily increased, generating a considerable

routine workload but with low yield. Nevertheless, during the period 1966 - 1988, a total of 100 malaria cases was detected through this channel, amounting to 11.5% of the total 873 cases registered. In 1984 the questionnaire was replaced by a simple form, perforated and detachable, half of which served as a questionnaire form and the other half advising the traveler to report to the nearest health authorities (health center or health station) in case of illness while staying in Taiwan. The questionnaire portion was turned over to the quarantine officer at the port of entry, and the advisory portion, on which telephone numbers of all health centers were listed, was retained by the traveler. In 1988 the system was again changed. In place of questionnaire forms, wallet-sized cards are being distributed by airline flight crews to passengers from malarious countries. The achievement of the control system against importation of cases using the questionnaire forms from 1966 through 1988 is summarized in Table 42 under "Ports of entry".

CASE DETECTION

The malaria surveillance network over the entire island was well established during the consolidation phase and proved very effective in detecting malaria cases and identifying transmission foci (Chapter VIII). However, as time passed, the level of collaboration, both individual and institutional, seemed to deteriorate rapidly. The number of malaria cases detected during the period 1966 - 1988 is also summarized in Table 42.

Table 42
Case Detection in Maintenance Phase in Taiwan (1966 - 1988)

| Sources | Blood Smears | 1966 - 1970 | 1971 - 1975 | 1976 - 1980 | 1981 - 1985 | 1986 - 1988 | Total Pos. |
|-------------------------------|---------------|-----------------|------------------|------------------|------------------|----------------|------------|
| Ports of Entry | Exam. Pos. | 47,494 11 | 82,325 26 | 154,618 19 | 144,648 36 | 146,533 8 | 100 |
| Private Clinics | Exam. Pos. | 7,511 34 | 5,755 85 | 10,786 64 | 21,565 130 | 15,477 80 | 393 |
| Voluntary Collaborators | Exam. Pos. | 413,020 9 | 292,866 13 | 284,306 3 | 26,517 0 | 0 0 | 25 |
| Health Stations | Exam. Pos. | 130,819 11 | 171,599 46 | 236,168 43 | 309,790 52 | 192,106 26 | 178 |
| Epidemiological Investigation | Exam. Pos. | 119,047 3 | 20,930 17 | 6,520 9 | 633 17 | 334 6 | 52 |
| Military Clinics | Exam. Pos. | 5,198 12 | 1,906 75 | 16 16 | 0 0 | 0 0 | 103 |
| Other Sources | Exam. Pos. | 644,181 9 | 635,522 3 | 646,700 8 | 548,513 1 | 250,791 1 | 22 |
| Grand Total | Exam. Pos. | 1,367,270 89 | 1,210,903 265 | 1,339,114 162 | 1,051,666 236 | 605,240 121 | 873 |

Exam. = Number of blood smears examined

Pos. = Number of blood smears found positives

Case Reporting by Clinics

This group included public and private physicians who took blood smears from suspected malaria cases. Although the number of blood smears submitted was small, the positivity rate was the highest. From 1966 - 1988, this group detected 393 cases, or 45% of the total cases registered during the 23-year period

Case Reporting by Voluntary Collaborators

This group collaborated well from 1966 through 1980; thereafter, their interest seemed to fade - perhaps understandably - as only 25 cases were detected out of the one million blood smears which they turned in during the period 1966 - 1988.

Fever Case Surveys at Health Stations

Blood smears were taken at health stations from all fever cases encountered. A total of 178 malaria cases was reported through this system during the 23 years from 1966 through 1988.

Epidemiological Investigations

The blood smears taken at the time of epidemiological investigations were also very important sources for case detection; furthermore, they were valuable in identifying and eliminating any transmission focus or foci.

Case Reporting by Military Clinics

Since 1956 the Chinese Armed Forces had assigned a liaison medical officer to TAMRI to ensure effective military participation in Taiwan's malaria program (Chapter X). Through the liaison officer, the military malaria surveillance units, and later the vigilance units, were organized for detecting and reporting malaria cases. In 1972 the military vigilance units were disbanded, but case reporting continued until 1974.

Other Case Detection Systems

These included case reporting by school teachers, fever case surveys at schools, and active case detection by TAMRI personnel in selected areas. These activities were virtually non-productive, case-wise, despite the many blood smears turned in for examination.

CASE INVESTIGATION

Epidemiological investigation was carried out on every case detected from January 1965 through December 1989. The work was conducted by TAMRI personnel, assisted by the respective county malaria supervisors. Classification of the cases investigated is presented in Table 43.

ENTOMOLOGICAL VIGILANCE

Following DDT residual house spraying in the attack phase period, *An. minimus* had disappeared from most of the malarious areas except in a small number of localities in the foothills. However, entomological surveys conducted in later years for monitoring purposes revealed that *An. minimus* was returning slowly but steadily in an increasing number of localities. The presence of this mosquito represents a potential danger of malaria transmission whenever and wherever a human parasite-carrier may appear. The entomological surveillance has always been conducted by TAMRI entomological personnel as a part of epidemiological investigation. In the maintenance phase, TAMRI continued to assume the same responsibility, sending its entomology teams to study the presence and density of *An. minimus* at fixed catching stations as well as at other strategic localities. However, these activities were greatly reduced after the only entomology technician in TAMRI was transferred to the medical entomology section of NIPM in 1989. The townships with one or more localities positive for *An. minimus* during the period 1966 - 1988 are shown *en bloc* in Map 13.

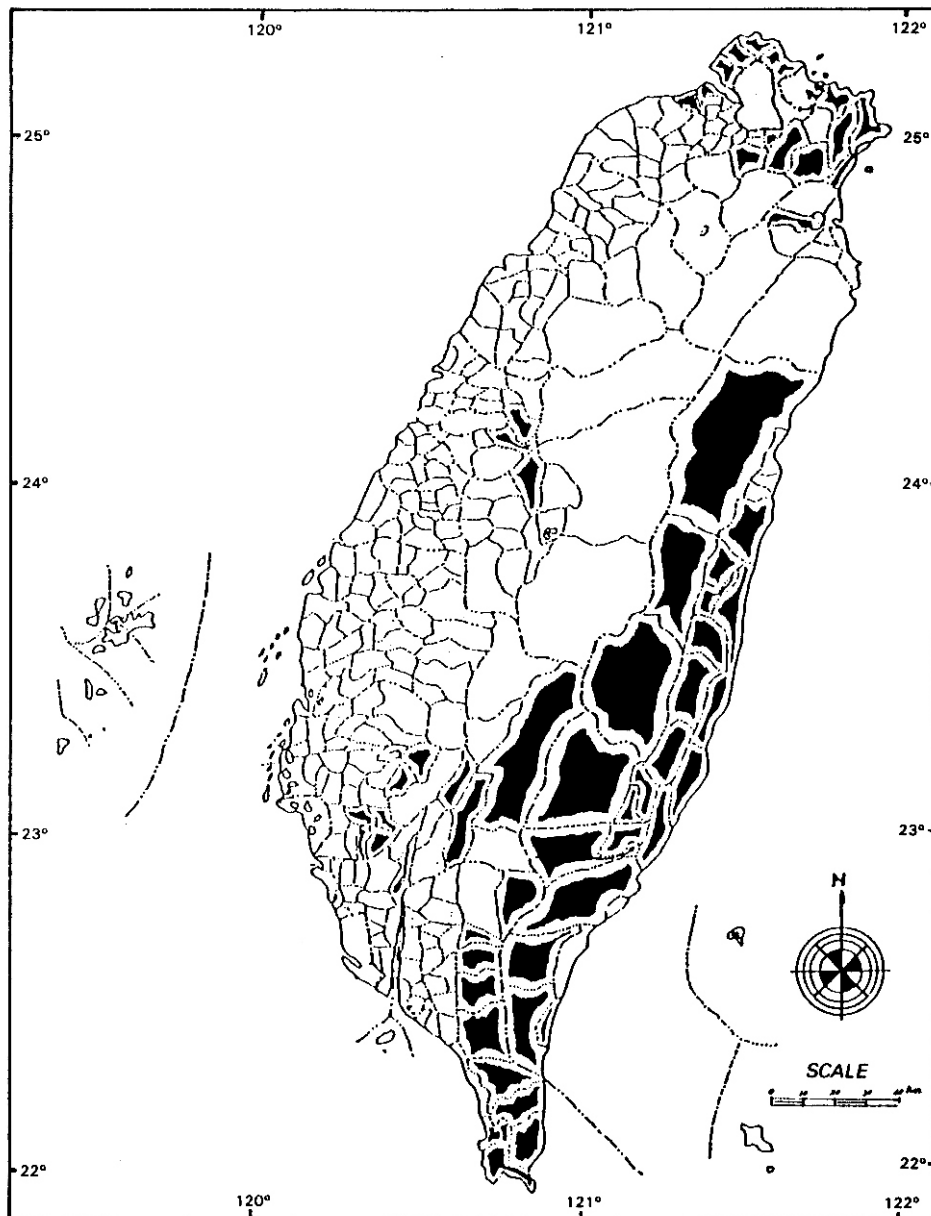
Table 43
Blood Smears Examined and Cases Found, by Sources of Infection
 1965 - 1989

| Year | Blood Smears Examined | No. Pos. | Cases by Source of Infection | | | | | | | | | |
|-------|-----------------------|----------|------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----|-------|
| | | | Indig. | Relapsing | | Induced | Imported | | | | | |
| | | | <i>Pv</i> | <i>Pv</i> | <i>Pm</i> | <i>Pm</i> | <i>Pf</i> | <i>Pv</i> | <i>Pm</i> | <i>Po</i> | Mix | Total |
| 1965 | 191,317 | 19 | 0 | 3 | 0 | 3 | 10 | 1 | 1 | 0 | 1 | 13 |
| 1966 | 203,306 | 30 | 15 | 0 | 0 | 1 | 4 | 6 | 0 | 3 | 1 | 14 |
| 1967 | 267,661 | 10 | 1 | 0 | 2 | 2 | 1 | 4 | 0 | 0 | 0 | 5 |
| 1968 | 285,009 | 14 | 1 | 0 | 1 | 2 | 1 | 5 | 1 | 3 | 0 | 10 |
| 1969 | 333,408 | 9 | 1 | 0 | 1 | 2 | 0 | 3 | 0 | 2 | 0 | 5 |
| 1970 | 277,886 | 26 | 5 | 0 | 0 | 0 | 7 | 12 | 0 | 2 | 0 | 21 |
| 1971 | 220,521 | 21 | 2 | 0 | 1 | 1 | 4 | 8 | 5 | 0 | 0 | 17 |
| 1972 | 264,166 | 46 | 28 | 0 | 2 | 0 | 3 | 10 | 3 | 0 | 0 | 16 |
| 1973 | 225,106 | 66 | 33 | 0 | 0 | 1 | 1 | 28 | 0 | 2 | 1 | 32 |
| 1974 | 230,720 | 49 | 0 | 0 | 0 | 0 | 13 | 35 | 0 | 0 | 1 | 49 |
| 1975 | 270,390 | 83 | 0 | 0 | 1 | 3 | 19 | 57 | 1 | 0 | 2 | 79 |
| 1976 | 251,119 | 44 | 0 | 0 | 0 | 0 | 6 | 32 | 1 | 3 | 2 | 44 |
| 1977 | 248,163 | 37 | 0 | 0 | 0 | 1 | 9 | 25 | 0 | 0 | 2 | 36 |
| 1978 | 290,811 | 26 | 0 | 0 | 0 | 0 | 11 | 14 | 0 | 1 | 0 | 26 |
| 1979 | 280,784 | 22 | 0 | 1 | 0 | 0 | 4 | 16 | 0 | 0 | 1 | 21 |
| 1980 | 268,237 | 33 | 0 | 0 | 1 | 2 | 6 | 22 | 2 | 0 | 0 | 30 |
| 1981 | 235,614 | 37 | 0 | 0 | 0 | 0 | 8 | 28 | 0 | 1 | 0 | 37 |
| 1982 | 215,089 | 52 | 0 | 0 | 1 | 1 | 18 | 29 | 0 | 0 | 3 | 50 |
| 1983 | 208,692 | 30 | 0 | 0 | 0 | 0 | 9 | 19 | 1 | 0 | 1 | 30 |
| 1984 | 206,651 | 65 | 0 | 0 | 0 | 0 | 22 | 41 | 2 | 0 | 0 | 65 |
| 1985 | 185,620 | 52 | 0 | 0 | 2 | 0 | 23 | 25 | 0 | 1 | 1 | 50 |
| 1986 | 188,075 | 40 | 0 | 0 | 0 | 0 | 14 | 25 | 1 | 0 | 0 | 40 |
| 1987 | 207,288 | 35 | 0 | 0 | 0 | 0 | 19 | 15 | 0 | 0 | 1 | 35 |
| 1988 | 209,877 | 46 | 0 | 0 | 1 | 0 | 19 | 26 | 0 | 0 | 0 | 45 |
| 1989 | 92,080 | 46 | 0 | 0 | 0 | 0 | 20 | 24 | 2 | 0 | 0 | 46 |
| Total | 5,857,590 | 938 | 86 | 4 | 13 | 19 | 251 | 510 | 20 | 18 | 17 | 816 |

No. Pos. = Number of positive cases detected; Indig. = Indigenous.

Population in: 1969 = 14,096,294 1984 = 18,872,725
 1974 = 15,708,627 1989 = 20,005,626
 1979 = 17,307,514

Map 13
Townships with One or More Localities Positive for An. Minimius,
Based on Surveys From January 1966 - December 1988
(shown *en bloc* in map)



ELIMINATION OF TRANSMISSION FOCI IN NORTHERN TAIWAN

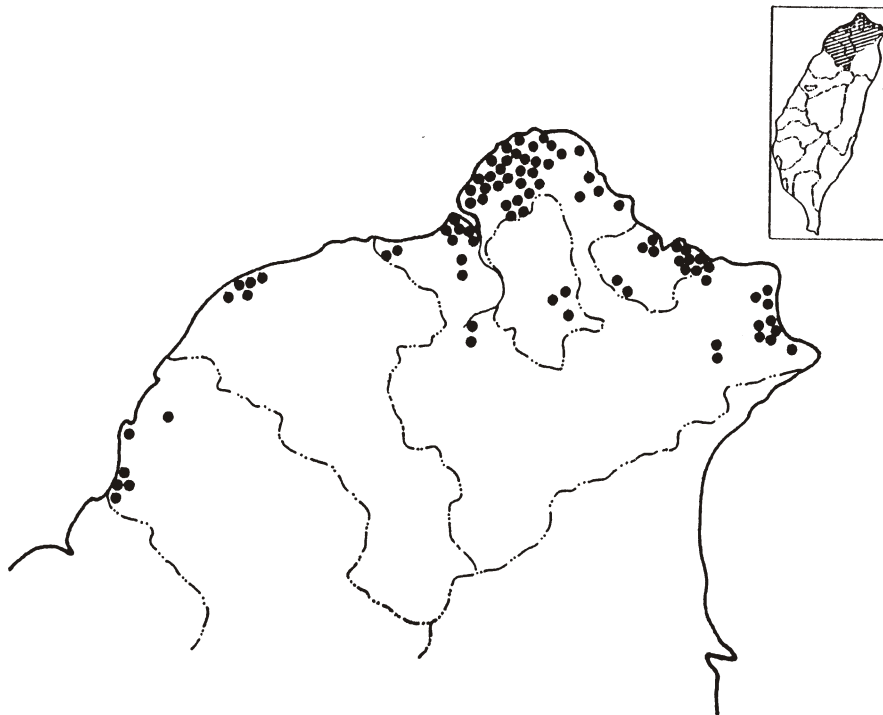
During the period July 1966 through August 1973, 86 indigenous *P. Vivax* cases were found in four counties - Taipei, Ilan, Taoyuan and Shinchu - and two cities -- Taipei and Keelung. Although the originating sources of infection were not clearly determined, it was suspected that they were from undetected relapsing cases inasmuch as *An. minimus* was present in small numbers in the localities wherever the indigenous cases were found. The first 25 cases were found from 1966 to 1971 in more than 10 small scattered localities. These cases were treated and the transmission foci eliminated. However, in 1972 and 1973, serious outbreaks were again observed in northern Taiwan, with 61 indigenous *P. vivax* cases in 24 transmission foci - 19 in Taipei county, three in Keelung city, and two in Taoyuan county (Map 14). To eliminate these foci, TAMRI, together with the local health stations and the county health centers, took the following remedial measures with special funds provided by NHA and PHA:

- * radical cure treatment for all 61 *P. vivax* cases, with three days chloroquine and 14 days primaquine;
- * residual house spraying with DDT and gamma-BHC (10:1) in all 490 subvillages of 59 villages in 10 townships and three districts, involving 10,255 households and 80,266 inhabitants;
- * examination of 79,904 blood smears; and
- * mass drug administration with a full course of radical cure treatment in the five most affected foci, which included 560 families in total.

After the elimination of these foci, a special three-year plan was put into practice in northern Taiwan from July 1974. To the present time, no further indigenous case has been found on the entire island.

Map 14

*Indigenous. P. vivax Infections in Northern Taiwan
(July 1966 - August 1973)*



PROBLEMS IN THE MAINTENANCE PHASE

The following major problems in malaria vigilance have been identified in the last 25 years. These problems are far from being solved. On the contrary, they threaten to become even more serious in the future.

Mistaken Optimism. A false security based on a belief that malaria has been eradicated and that antimalaria activities are no longer necessary is generalized and deep-rooted. Almost all difficulties confronted by the malaria vigilance program stem from this unjustified optimism.

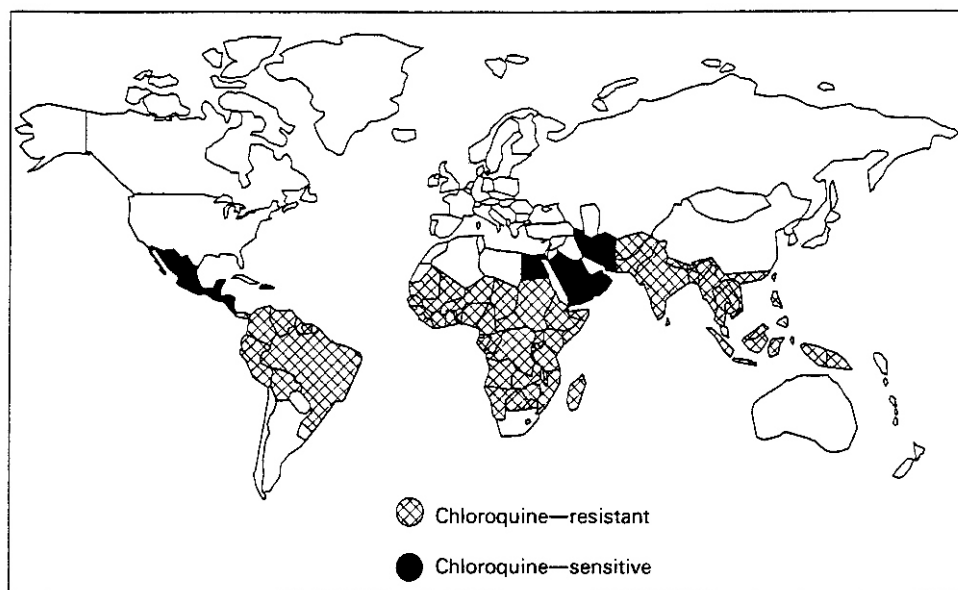
Insufficient Budgets. Malaria budgets at county and township levels are insufficient to permit even minimum case detection activities.

Lack of Experienced Malaria Workers. At all levels, the experienced malaria workers are either retired, about to retire, or reassigned to other health projects. Personnel currently in charge of malaria work on a part-time basis are inexperienced and/or without proper training.

Inadequate Screening of International Travelers. Such screening is virtually nil at ports of entry inasmuch as use of the questionnaire forms has been discontinued. Control of international travelers is admittedly difficult, but should never be ignored. Alarming, the number of malaria cases has been increasing in Asia, Latin America and Africa south of the Sahara (*World Health*, December 1989). *P. falciparum* resistance to chloroquine is also increasing in intensity and geographical extension (Map 15).

Map 15

*Malarious Areas with P. Falciparum
Resistant or Sensitive to Chloroquine, 1990*



Source: U.S. Department of Health and Human Services,
Morbidity and Mortality Weekly Report, March 9, 1990

Progressive Loss of Unified Direction. Perhaps the most important problem facing malaria vigilance in Taiwan is the evidence of the disintegration of the former nuclear malaria organization -- TAMRI. Without dynamic direction and coordination by such an organization, it is difficult or virtually impossible to maintain an adequate malaria vigilance and the essential, constant monitoring demanded by *An. minimus*, a potentially explosive primary vector.

Erroneous Diagnosis and Improper Treatment. Not having encountered malaria cases for many years, local physicians tend to forget malaria and may make faulty diagnoses, costing precious lives and bringing tragedy to an entire family. There follow two examples deserving attention and reflection by medical professionals.

Example A: During the period 1966 - 1984, no fatal cases of malaria infection were reported in Taiwan. On February 26, 1985 a pregnant woman returning from Liberia had an onset of clinical symptoms of malaria a few days after arrival in Taiwan, and saw a number of private physicians, none of whom gave a diagnosis of malaria. Some of the physicians even told her that the prophylactic tablets (*i.e.*, chloroquine) given to her by the health services should not be taken because of her pregnancy. She became increasingly ill and was finally admitted into a general hospital in Taipei where she was diagnosed as having a heavy infection with *P. falciparum* RTS+++ (ring trophozoite schizont), with comatous cerebral syndrome. Although the hospital immediately reported the case to the Health Department of Taipei Municipality and to the then Institute of Infectious Diseases in Nankang, the supply of injectable quinine became available too late to save her life. She died of malaria in a country free from malaria transmission.

Example B: The year 1986 was free from any malaria death. However, on September 15, 1987 another young woman, returning to Taiwan from Cameroon, was not given a timely and correct diagnosis of a *P. falciparum* infection or the proper antimalaria treatment to save her life.

Every year since then, at least one malaria death has occurred from imported *P. falciparum* infections. There were two malaria deaths in 1990 -- one a returnee from Nigeria and the other a returnee from Laos.

Among the 268 imported cases of *P. falciparum* and mixed infection since 1965, six cases were fatal due to untimely diagnosis and treatment.